Cucurbitaceae 2010

14–18 November 2010

Francis Marion Hotel

Charleston, South Carolina

Conference Program and Schedule

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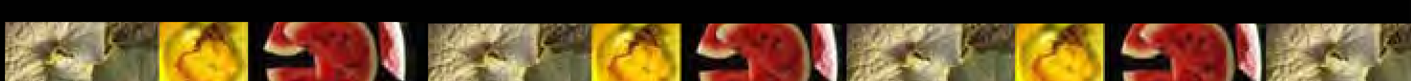

Cucurbitaceae 2010

Conference Schedule *(subject to change)*

Sunday, 14 November

2:00–6:00 pm **Registration Open**...Registration Counter

5:30–7:00 pm **Welcome Reception**...Gold Ballroom

Monday, 15 November

7:00–7:45 am **Continental Breakfast**... Carolina B

8:00–10:00 am **General Session** ... Carolina A

8:00 am Welcome & Announcements
Judy A. Thies

8:10 am U.S. Vegetable Laboratory, USDA, ARS, Charleston, SC
Richard L. Fery

8:20 am Clemson University, Charleston, SC
Anthony P. Keinath

8:30 am ***Keynote:* "Cucurbitaceae" Comes to the USA**
Claude E. Thomas (see page 9 of progam)

9:00 am ***Keynote:* From Native Plants in Central Europe to Cultivated Crops Worldwide: The Emergence of *Didymella bryoniae* as a Cucurbit Pathogen**
Anthony P. Keinath (see page 10 of progam)

10:00–10:30 am **Break**... Prefunction A

10:30 am–12:00 pm **Cucurbit Rootstock and Grafting Symposium**... Carolina A
Moderators: Menahem Edelstein & Richard Hassell

10:30 am Optimization of Agrotechnology for Grafted Melons in Israel: Pathological and Physiological Aspects
Roni Cohen*, Asaf Porat, Menahem Edelstein, Shimon Pivonia, Amnon Koren, Shimshon Omer, and Nabil Omari

10:45 am An Overview on Watermelon Grafting in Turkey
Halit Yetişir*, Nebahat Sari, İlknur Solmaz, and K. Savas Titiz

11:00 am Cow Watermelon (*Citrullus lanatus* var. citroides) Lines are Useful Rootstocks for Managing Root-knot Nematodes in Grafted Watermelon
Judy A. Thies*, Jennifer J. Ariss, Richard L. Hassell, Steve Olson, Chandrasekar S. Kousik, and .Amnon Levi

11:15 am Utilizing Cucurbit Grafting in Eco-Sustainable Strategies under Biotic and Abiotic Stresses
A.A. Glala

11:30 am New Watermelon (*Citrullus lanatus*) Grafting Method to Eliminate Rootstock Side Shoots
Richard L. Hassell

11:45 am Discussion

12:00–1:30 pm **Lunch On Your Own**

1:30 –2:45 pm **Cucurbit Rootstock and Grafting Symposium**... Carolina A
Moderators: Halit Yetisir & Fenny Dane

1:30 pm Greenhouse and Field Evaluation of Multiple Virus Resistant *Lagenaria siceraria* Lines Potentially Useful for Watermelon Rootstocks
K.-S. Ling*, A. Levi, C.S. Kousik, R. Hassell, A. Keinath, G. Miller, and S. Adkins

1:45 pm Effect of Crown Rot Caused by *Phytophthora capsici* on Cucurbit Rootstocks and Grafted Watermelon
Chandrasekar S. Kousik*, Ryan Donahoo, and Richard Hassell

2:00 pm Using Cucurbita Rootstocks as Biological Filters to Prevent Toxic Element Penetration into Plants and Fruits
Menahem Edelstein*, Zvi Plaut, and Meni Ben-Hur

2:15 pm Impact of Grafting on NAC Gene Expression in *Citrullus colocynthis* and *C. lanatus* during Drought
Ying Si, Ying Huang, K.K. Kang, and Fenny Dane*

2:30 pm Discussion

2:45–3:15 pm **Break**........ Prefunction A

3:15–5:00 pm **Plant Pathology**........ Carolina A
Moderators: Ales Lebeda and Benny Bruton

3:15 pm Bacterial Spot (*Xanthomonas campestris* pv. *cucurbitae*): A Serious Threat to the Pumpkin Industry in Illinois
M. Babadoost* and A. Ravanlou

3:30 pm On the Reliability of *Fusarium oxysporum* f. sp. *niveum* Research: Do We Need Standardized Testing Methods
Benny D. Bruton*, Wayne W. Fish, Elisabetta Vivoda, Brad Gabor, and Kathryne L. Everts

3:45 pm Fungicide Applications to the Soil during the Growing Season for the Control of Melon Sudden Wilt Caused by *Monosporascus cannonballus*
Shimon Pivonia, Amikam Maduel, Rahel Levita, and Roni Cohen*

4:00 pm Prevalence of Virus Diseases of *Cucurbita pepo* in the Mid-Atlantic Region of the United States
Kathryne L. Everts*, Karen Rane, Gerald Brust, and Barbara Scott and Mark VanGessel

4:15 pm Susceptibility of Cucurbit Species to Gummy Stem Blight and Their Suitability for Reproduction by *Didymella bryoniae*
Anthony Keinath

4:30 pm Temporal Population Dynamics of *Pseudoperonospora cubensis*
A. Lebeda*, J. Hübschová, and J. Urban

4:45 pm Factors That Influence Exposure Rates and Transmission of *Erwinia tracheiphila* in *Cucurbita pepo*
Andrew Stephenson

5:30–6:30 pm **Pickling Cucumber Improvement Committee**........ Carolina A

6:30–7:30 pm **Cucurbit Genetics Cooperative**........ Carolina A

Dinner Own Your Own

Tuesday, 16 November

6:30–7:15 am **Continental Breakfast**........ Carolina B

7:30–4:30 pm **Full Day Tour (Lunch Provided)**

5:00–6:00 pm **Squash Research Group**........ Carolina A

6:00–7:00 pm **Cucurbit Crop Genetics Committee**........ Carolina A

Wednesday, 17 November

7:00–7:45 am **Continental Breakfast**........ Carolina B

8:00–10:00 am **Breeding and Genetics**........ Carolina A
Moderators: Jordi Garcia-Mas & Nebahat Sari

8:00 am Search for Higher Resistance to the New Race of Downy Mildew in Cucumber
Adam D. Call* and Todd C. Wehner

8:15 am Genetic Variance Estimation for Yield and Some Fruit Traits of Melon Using Diallel Cross Analysis
Nadia M. Omar, Ahmed A. Glala, and Sara E.I. El-Dessouky*

8:30 am Genetic Mapping of Chromosomal Segments Introgressed in Cultivated Watermelon Genome
Amnon Levi*, W. Patrick Wechter, Kai-shu Ling, Judy A. Thies, and Don Hopkins

8:45 am Sequencing the Genome of Melon (*Cucumis melo* L.)
A. Benjak, G. Mir, M. Bourgeois, P. Arús, J. Garcia-Mas*, V. Gonzalez, P. Puigdomènech, M. Álvarez-Tejado, M. Droege, and L. Du

9:00 am	The Unique Mitochondrial Genetics of Cucumber Claudia Calderon, Michael J. Havey*, Sulieman Al-Faifi, Grzegorz Bartoszewski, and Stefan Malepzy	
9:15 am	A Glance at Microsatellite Motifs from 454 Sequencing Reads of Watermelon Genomic DNA Padmavathi Nimmakayala, Amnon Levi, Sathish K. Ponniah, Yan Tomason, Gopinath Vajja, Patrick Wechter, and Umesh K. Reddy*	
9:30 am	Efficient Breeding Methods for Yield in Watermelon: A Review Mahendra Dia, and Todd C. Wehner	
9:45 am	Amino Acid Catabolism into Aroma Volatiles in Melon (*Cucumis melo* L.) Fruit Itay Gonda, Einat Bar, Vitaly Portnoy, Shery Lev, Joseph Burger, Arthur A. Schaffer, Ya'akov Tadmor, Nurit Katzir, Efraim Lewinsohn*, Shimon Gepstein, and James J. Giovannoni	
10:00–10:30 am	**Break**	Prefunction A
10:30 am	**National Watermelon Promotion Board: International Activities** Mark Arney, Executive Director, National Watermelon Promotion Board, Orlando, FL	Carolina A
10:45 am–12:00	**Biotechnology, Physiology, and Genetics** Moderators: Nurit Katizir & Efraim Lewinsohn	Carolina A
10:45 am	Effect of Floral-primordia Targeted Ethylene Production on Sex Determination in Melon (*Cucumis melo* L.) Jessica Taft*, Holly Little, Sue Hammar, and Rebecca Grumet	
11:00 am	Transcriptomic Analysis of Cucumber Fruit Development Kaori Ando and Rebecca Grumet*	
11:15 am	Sugar Accumulation and Enzyme Activities in an Acidic Hami Melon Cultivar Mi Tang, Bao-cai Zhang, Zhi-long Bie*, Ming-zhu Wu, Hong-ping Yi, and Jong-xin Feng	
11:30 am	Digital Transcriptomics of Melon Developing Fruit Vitaly Portnoy, Sheri Lev, Rotem Harel-Beja, Galil Tzuri, Tamar Lahav, Joseph Burger, Uzi Sa'ar, Efraim Lewinsohn, Yaakov Tadmor, Nurit Katzir*, Alex Diber, Sara Pollock, and Arthur A. Schaffer	
11:45 am	Obtaining Tetraploid Watermelon Plants by In Vivo and In Vitro Methods Sezen Inan and Nebahat Sari*	
12:00–1:30 pm	**Lunch On Your Own**	
1:30–3:00 pm	**Germplasm, Breeding, and Genetics** Moderators: Elzbieta Kozik & Rebecca Grumet	Carolina A
1:30 pm	Genetic Diversity in Watermelon Germplasm using SSR Markers Yunyan Sheng, Feisi Luan*, and Faxing Zhang	
1:45 pm	The Utility of a Database and Photographic Record of *Cucurbita Herbarium* Specimens Thomas C. Andres* and Michael H. Nee	
2:00 pm	Multiple Flowering as an Adaptation of Summer Squash for Growing in Protected Culture Harry S. Paris	
2:15 pm	Association Mapping of Fruit Traits and Phytomedicine Contents in a Structured Population of Bitter Melon (*Momordica charantia* L.) Chittaranjan Kole*, Bode A. Olukolu, Phullara Kole, and Albert G. Abbott	
2:30 pm	New Sources of Resistance to Downy Mildew in Cucumber Urszula Klosinska, Elzbieta U. Kozik*, Adam Call, and Todd C. Wehner	
2:45 pm	New Relatives of Cucumber and Melon from Australia Patrizia M. Sebastian* and Susanne S. Renner	
3:00–5:00 pm	**Poster Session**	Carolina B
5:00–6:00 pm	**Watermelon Research Group**	Carolina A
6:00–7:00 pm	**Melon Breeders Group**	Carolina A
7:30–8:00 pm	**Pre-banquet Gathering**	Lobby Bar/Colonial Foyer

8:30–10:30 pm **Banquet, Awards Ceremony, and Dancing**.. Colonial Ballroom

Presentation of Cucurbitaceae 2010 Lifetime Achievement Awards to:

Claude E. Thomas, Research Plant Pathologist and Research Leader, U.S. Vegetable Laboratory, USDA, ARS (retired), Charleston, SC, USA

Donald Hopkins, Plant Pathologist, University of Florida, Apopka, FL, USA

Nurit Katzir, Geneticist and Research Director, Newe Ya'ar Research Center, Ramat Yishay, Israel

Gary Elmstrom, Plant Breeder, Sun Seeds (retired), Acampo, CA, USA

Tom Williams, Plant Breeder, Rogers–Syngenta Seeds (retired), Naples, FL, USA

Thursday, 18 November

7:00–7:45 am **Continental Breakfast**..Carolina B

8:00–10:00 am **Breeding and Genetics**... Carolina A
Moderators: Yong Xu & Yaakov Tadmor

8:00 am A Yellow-orange-flesh Melon Mutant Accumulating Tetra-cis-lycopene Instead of ß-Carotene as its Major Fruit Carotenoid
Yaakov Tadmor*, Yosi Burger, Tamar Lavee, Ayala Meir, Galil Tzuri, Vitaly Portnoy, Einav Shimoni-Shor, Uzi Sa'ar, Fabian Baumkoler, Efraim Lewinsohn, Nurit Katzir, and Arthur A. Schaffer

8:15 am Changes of Protective Enzyme Activities in Seedling Stages of Watermelon Exposed to *Phytophthora capsici*
Yong-Qi Wang*, Xian Zhang, Feng Xian, and Wen-Chao Zhu

8:30 am Cucumber Phylogeny, Genetics and Genomics as of 2010
Yiqun Weng

8:45 am Papaya Ringspot Virus Resistance in Selected F2:3 Families of Tropical Pumpkin Does Not Support a Single Recessive Gene Model
Robert McPhail-Medina, Linda Wessel-Beaver*, Jose Carlos V. Rodrigues, and Andrés E. Velázquez-Márquez

9:00 am International Watermelon Genomics Initiative (IWGI): Advance and Orientation
Yong Xu*, Shaogui Guo, Zhangjun Fei, Haiying Zhang, Yi Ren, Hong Zhao, Guiyun Lv, Guoyi Gong, Qinghe Kou, Xiaohua Zou, Hui Wang, and Wenju Hou

9:15 am Polymorphism Analyses of Watermelon (*Citrullus lanatus*) Mapping Parents Using RAPD and ISSR Molecular Markers
Xing P. Yang*, X. Lin Hou , G. Liu, J. Hua Xu , and C. Zhou Gao

9:30 am A Novel Inbred Squash Line Developed from Interspecific Crosses between *Cucurbita maxima* and *Cucurbita moschata*
Nakkanong Korakot, Jinghua Yang, Mingfang Zhang*, Feihua Ye, and Yi Lin

9:45 am Resistance to Cucumber Mosaic Cucumovirus (CMV) in Melon (*Cucumis melo* L.) is Governed by One Gene and Two QTLS
Ana Montserrat Martín-Hernández*, Cèlia Guiu Aragonés, Jordi Garcia-Mas, and Antonio J. Monforte

10:15–11:15 am **Virology** .... Carolina A
Moderators: Linda Wessel-Beaver & Feishi Luan

10:15 am Physiological Effects Induced by Squash Vein Yellowing Virus, Causal Agent of Viral Watermelon Vine Decline in Florida
Scott Adkins*, Craig G. Webster, T. Greg McCollum, Joseph P. Albano, William W. Turechek, Pamela D. Roberts, Susan E. Webb, Carlye A. Baker, and Chandrasekar S. Kousik

10:30 am Responses of Various Vining Cucurbits to Squash Vein Yellowing Virus Infection
C.G. Webster*, W.W. Turechek, C.S. Kousik, P.D. Roberts, S.E. Webb, and S. Adkins

10:45 am Epidemiology and Association of Four Insect-vectored Viruses in Florida Watermelon
W.W Turechek*, C.G. Webster, S. Adkins, P.A. Stansly, P.D. Roberts, and C.S. Kousik

11:00 am Cucurbits—A Paradise of Begomoviruses?
R.W. Briddon, M.S. Haider, and M. Tahir*

11:15 am-12:30 **Business Meeting and Closing Remarks** .... Carolina A

*Denotes Presenting Author

—Keynote Address—

Cucurbitaceae Comes to the USA

Claude E. Thomas

USDA, ARS, U.S. Vegetable Laboratory (retired)

Charleston, SC 29414 USA

In the United States, the Cucurbitaceae meeting began as a copy of the EUCARPIA sponsored meetings of the same name, which every four years brought together cucurbit researchers primarily from Europe and the Mediterranean areas. Several of us from the USA attended the Cucurbitaceae 88 meeting in Avignon, France and were so impressed by its content, approach, and attendance that we decided that such a meeting would be very useful to the cucurbit scientific community in the USA. So those of us who had attended Cucurbitaceae 88, Tom Williams, Dave Groff, Jim McCreight, Kristina M-Ladd, Jon Waterson and I decided to give it a try in this country. We saw its value in bringing together scientists from various discipline areas who were engaged in research on cucurbit crops. We hoped to attract strong attendance not only from USA scientists, but also from the international scientific community. Since we settled on Charleston, SC as the location for the meeting and I lived in Charleston and worked at the U.S. Vegetable Laboratory, I ended up as chairman of the Organizing Committee for Cucurbitaceae 89.

That first meeting in Charleston was held November 20 through December 2, 1989, about 18 months after the EUCARPIA sponsored meeting in Avignon. Looking back, we were somewhat foolhardy to think we could pull together a worthwhile international meeting in such a short period. Especially since that was back in a time when professional societies did not offer to handle the particulars of such meetings. Therefore, we did it all ourselves, everything related to the meeting: announcements, hotel and food arrangements, selection of invited speakers, solicitation of support from the seed industry, editing and printing the proceedings, arranging tours, registration, etc. From my standpoint, I was most fortunate at the time to have Ellis Caniglia working in my project and she was a tremendous help in all the things that needed to be done and consequently was a major contributor to the success of the meeting. Of course all of our labors were hampered by the major recovery effort required to deal with the devastation wrought when hurricane Hugo blew into Charleston on September 21, 1989 at high tide with 135 mph winds and a 13- to 14-foot storm surge. With less than two months until the meeting, we struggled along for over a month with a portable generator providing only the most essential electrical services to our laboratory-office building. However, the outcome of our efforts was a successful meeting that brought together 92 scientists from the USA, Europe, the Mediterranean area, and Asia.

I believe that aside from the hard work put forth in planning and conducting this first Cucurbitaceae meeting in the USA, it was also successful because it came at just the right time in this country for such a commodity-oriented research meeting on cucurbits. Up through the 1970s, most southern and some western and Midwestern state universities had one or more cucurbit breeders on their staffs, but by the mid-1980s most of these positions no longer existed, because when these classical plant breeders retired, if they were replaced, it was usually with newly trained, biotech oriented scientists. All aspects of classical plant breeding with cucurbit crops, including prebreeding, were becoming more and more the sole responsibility of the seed companies. There were a couple of strong commodity groups (pickles and watermelon), but their meetings were not primarily aimed at research needs or in-depth discussions of on-going problem solving research. The usefulness of the Cucurbitaceae meeting was that it involved many scientific disciplines, bringing together in an intensely focused setting researchers that normally had little contact or interaction in the various scientific society meetings of their different discipline areas. It also enhanced and promoted interaction between researchers in the public and private sectors by extending the spheres of professional contacts between these cucurbit researchers. The resultant heightened awareness of the research efforts of fellow cucurbit scientists increased interactions among these researchers and accelerated the progress of research on cucurbit crops. Overall, the success of the initial Cucurbitaceae 89 meeting in the USA is best attested by its perpetuation at approximately four-year intervals since that first meeting with even better and more strongly attended Cucurbitaceae meetings.

Welcome back to Charleston!

—Keynote Address—

From Native Plants in Central Europe to Cultivated Crops Worldwide: The Emergence of *Didymella bryoniae* as a Cucurbit Pathogen

Anthony P. Keinath

Clemson University

Charleston, South Carolina, 29414 USA

Additional Index Words. seed, *Bryonia alba*, *Cucumis sativus*, *Citrullus lanatus*

Didymella bryoniae (Auersw.) Rehm, 1881 was first described in 1869 from *Bryonia* (bryony or wild hops) in central Europe. Today, this cucurbit pathogen is found on six continents on at least 12 genera and 23 species of cucurbits. How did *D. bryoniae* evolve from a pathogen of a native plant in central Europe to a worldwide threat to cucurbits cultivated in humid environments? Clues from the early discoveries of this fungus, its characteristics as a seedborne pathogen, and its broad adaptation to cucurbit hosts will provide some answers to this question.

Early Reports of *D. bryoniae* and Gummy Stem Blight

Both Bernhard Auerswald and Karl W. G. L. Fuckel, working independently, described *Didymella bryoniae* (Auersw.) Rehm in 1869 from specimens collected on the cucurbit *Bryonia* growing in Germany. Although neither mycologist assigned the fungus to the correct genus, both coined the species name "bryoniae," following the convention that the specific epithet of the fungus should be taken from the genus of the plant host (Table 1). Because Auerswald's report was published in 1869 and Fuckel's report was not published until 1870, Auerswald's name has priority according to most mycologists.

The earliest collection and report of *D. bryoniae* on a cultivated cucurbit is from *Cucumis melo* L. in Italy, collected in an unknown year and described as *Didymella melonis* Pass. by Giovanni Passerini in 1885 (Corlett, 1981) (Table 1). The next reports on cultivated cucurbits came from cucumber in France by Casimir Roumeguère and from watermelon [*Citrullus lanatus* (Thunb.) Matsum. & Nakai] in Delaware, United States; both were published (independently) in 1891 (Chester, 1891; Roumeguère, 1891 in Corlett, 1981). According to Chiu and Walker (1949), the cucumber grown in France was a Chinese variety. Frederick Chester (1891), a plant pathologist, noted that the disease had already occurred "for some years past" and resulted in "widespread financial disaster wherever it gains foothold." Both authors observed only pycnidia on their specimens, since they named their pathogens *Ascochyta cucumis* Fautr. & Roum. and *Phyllosticta citrullina* Chester with generic names of anamorphic fungi combined with new species names based on the particular host. Another collection of the pycnidial state also was made in 1891, when William Dudley found *D. bryoniae* on cucumber in a greenhouse on the Cornell University campus. Several years later, *D. bryoniae* was found in the Midwestern United States, again on cucumber, by the botanist and plant pathologist Augustine Selby (Table 1). In the first decade of the 20th century, additional collections and reports appeared from additional states in the USA and Puerto Rico (Farr and Rossman, 2010).

It is interesting to note that i) the earliest collections of *D. bryoniae* were on *Bryonia* and ii) pseudothecia were present in each case. In contrast, the collections in the 1890s were all from cultivated cucurbits, on which either only pycnidia had formed or the collectors overlooked pseudothecia. Because a variety of names have been assigned to this fungus, it took several more decades until the connection was made between *D. bryoniae* and its asexual state. Whether *D. bryoniae* spread from *Bryonia* to vegetable cucurbits cannot be determined, since there were no early collections of the fungus from both hosts in the same location. More likely, with the increased knowledge of basic plant pathology, gummy stem blight came to be recognized as a disease of cucurbits caused by a fungus. That this happened independently during this period can be seen from the variety of names assigned to the pathogen. Thus, botanists, mycologists, and plant pathologists discovered *D. bryoniae* because it attracted their attention in their localities, not because they had read reports in the literature.

In the meantime, one of the early hosts, *B. alba* (white byrony), was introduced into the United States several times in the 19th century as an ornamental and medicinal plant. Subsequently, it escaped from cultivation and became established in the Pacific Northwest (Novak and Mack, 1995). Currently, *B. alba* is present in Washington, Idaho, Montana, and Utah; in Washington, it is

Table 1. Pre-1900 collections of host plant material with *pseudothecia* or *pycnidia* of *Didymella bryoniae* (Auersw.) Rehm[z]

Year[y]	Location	Host	Collector	Name
~1869	Germany	*Bryonia cretica*	G. Rabenhorst	*Sphaerella bryoniae* Auersw.
~1870–1874	Czech Rep.	*Bryonia alba*	G. Niessl	*Sphaerella bryoniae* Auersw.
1876	England, UK	*Bryonia alba*	C. Plowright	*Sphaeria bryoniae* Fuckel
~1870- 1881	Hessen, Germany	*Bryonia* sp.	L. Fuckel	*Didymella bryoniae* (Fuckel) Rehm
~1885	Italy	*Cucumis melo*	G. Passerini	*Didymella melonis* Pass.
1891	New York, USA (Cornell greenhouse)	*Cucumis sativus*	W. Dudley	*Phyllosticta cucurbitacearum* Sacc.
1891	France	*Cucumis sativus*	C. Roumeguère	*Ascochyta cucumis* Fautr. & Roum.
1891	Delaware, USA	*Citrullus lanatus*	F. Chester	*Phyllosticta citrullina* Chester
1898	Ohio, USA	*Cucumis sativus*	A. Selby	*Phyllosticta cucurbitacearum* Sacc.

[z]Based on information in Robert et al., 2005, Corlett, 1981, and Farr and Rossman, 2010.

[y]Estimated years of collection are based on the publication date of the name assigned to the specimen.

considered a noxious weed. *D. bryoniae* has never been found on *B. alba* in the United States (S. J. Novak, pers. comm., 19 June 1997). The most likely reason for this is that *B. alba* is found in arid environments, such as southeastern Washington, that are not conducive for *D. bryoniae*. In addition, the phenology of *B. alba* reduces the likelihood of contact between pathogen and host. *B. alba* is deciduous; "the stems emerge from the tuberous root in mid to late spring, and this is after the majority of the years' precipitation has fallen" (S. J. Novak, pers. comm., 19 June 1997).

A Seedborne Cucurbit Pathogen

D. bryoniae may be present both on and in cucurbit seed. One of the first reports to confirm contaminated seed as the source of inoculum for an outbreak of gummy stem blight came from England. In this case, infested seed used for commercial crops of greenhouse cucumbers that developed gummy stem blight produced 6% diseased seedlings in a blotter test (Brown et al., 1970). Certainly, the transition from direct seeding to transplanting cucurbits in modern agricultural systems has heightened the importance of *D. bryoniae* as a cucurbit pathogen. It consistently, albeit infrequently, appears on cucurbit seedlings in greenhouses, generally when the first true leaf appears. The typical pattern is a dead plant that grew from a contaminated seed (primary infection) surrounded by symptomatic plants (secondary infections). In greenhouse experiments, 11% to 15% of seedlings adjacent to infected source seedlings became infected (Keinath, 1996), although higher rates of infection have been observed in commercial transplant greenhouses (Keinath, unpublished).

van Steekelenburg (1986) demonstrated that cucumber fruit became infected after blossoms were inoculated with *D. bryoniae*. de Neergaard (1989a) traced the path of infection from conidia applied to the stigma through the style and funiculus to the ovules, which provided evidence of how cucurbit seed becomes infected with *D. bryoniae*. In a study done at The Danish Seed Health Center for Developing Countries in Copenhagen, cucurbit seeds from several countries were dissected and cultured. *D. bryoniae* was present primarily on or in the seed coat and perisperm and occurred less frequently on the cotyledons (Lee et al., 1984). In addition, an internal fruit rot of cucumber was reported first in Japan in 1960 and then in Europe and other locations (Kagiwata, 1970; van Steekelenburg, 1986; de Neergaard, 1989a). In Europe, affected fruit lacked any external symptoms. Growth of *D. bryoniae* as black mycelium also has been observed inside melon (*C. melo*) and giant pumpkin (*C. maxima*) fruits (Keinath, unpublished). It is possible that this type of internal fruit infection could lead to seeds becoming infested with *D. bryoniae* on the outside of the seed coat. Because fruit are externally asymptomatic, they could easily be harvested and processed for seed extraction.

The use of grafted cucurbits further increases the risk of gummy stem blight development from seedborne inoculum. After grafting, plants are held at high humidity or under frequent misting to promote healing of the graft union. These environmental conditions are very favorable for development of gummy stem blight (Arny and Rowe, 1991). Recently, gummy stem blight was observed on grafted watermelon in Tunisia as cankers at the graft union that killed affected plants (Boughalleb et al., 2007). Because gummy stem blight was not observed on non-grafted plants or on leaves, it is likely that the grafted plants became infected in the greenhouse, since it is unlikely that another source of *D. bryoniae* inoculum was present in the arid North African climate.

Interactions between *D. bryoniae* and its Cucurbit Hosts

D. bryoniae is host-specific on cucurbits (Corlett, 1981). It, like many foliar fungal pathogens, is limited to members of one host plant family. Given the natural variability in severity of symptoms on inoculated plants, the host from which isolates are recovered has no consistent effect on virulence of isolates on other cucurbit species (Lee et al., 1984; Zúniga, 1999). This implies that isolates of *D. bryoniae* from wild hosts, e.g. *Bryonia* or *Sicyos angulatus*, would readily infect cultivated species. On the other hand, *D. bryoniae* is very well adapted to cucurbits. At least 12 cucurbit genera and 23 species are hosts, i.e. can be infected and become diseased (Table 2). Nevertheless, there are consistent differences among some cucurbits. For example, summer squashes (*C. pepo*) are resistant to—or less susceptible to—gummy stem blight relative to other commonly cultivated cucurbits (Sitterly, 1969; Keinath et al., 2009).

D. bryoniae grows rapidly in planta. Lesion expansion has been estimated to be 0.5 cm in 12 h (Keinath, unpublished). Epidemic progress of 6% (0.06) disease severity per day has been recorded on nonsprayed fall watermelon growing in a conducive environment (Keinath, 1995). The pathogen appears to be tolerant of desiccation after infection and likely survives in planta as dormant mycelium (Chiu and Walker, 1949). It survives in dead, infected host debris for up to 2 years in semi-tropical climates (Keinath, 2008), which is longer than it survived in northern climates (Chiu and Walker, 1949; van Steekelenburg, 1983).

D. bryoniae reproduces readily on all parts of cucurbits, including leaves, petioles, vines, tendrils, stems, pedicels, flowers, peduncles, fruits, seeds, and roots (Chester, 1891; de Neergaard, 1989a; Keinath, 2010; Lee et al., 1984). Since *D. bryoniae* is a necrotrophic fungus, fruiting bodies are found in the center or the oldest part of lesions. In general, pycnidia are formed earlier than pseudothecia, although the opposite also has been reported on cucumber (de Neergaard, 1989b). Mean number of both pseudothecia and pycnidia per square centimeter of leaf lesions ranged from 222 ± 58 to 579 ± 58 (Keinath, 2010). There were no differences in number of fruiting bodies per unit area on different cucurbit species. Thus, all cucurbit hosts could provide a substrate for production of airborne ascospores capable of disseminating the pathogen (Schenck, 1968). However, how far viable ascospores are capable of traveling has not been determined.

Current theory on co-evolution of pathogens and host plants holds that resistance to a pathogen is most likely to occur when the pathogen is present in the plant's center of origin and exerts selection pressure on the host. For example, 14 *Citrullus colocynthis* accessions from Iran (7), Afghanistan (3), Egypt (2), Morocco (1) and Cyprus (1) were very susceptible to *D. bryoniae* (Levi et al., 2001). Because *C. colonythis* is a desert species, and most of the accessions were collected from countries with arid climates, it is

Table 2. Cucurbit genera reported to be infected by *Didymella bryoniae*

Genus (number of species infected)	Common name	Primary Reference
Bennincasa (1)	wax gourd	Wiant, 1945
Bryonia (3)	bryony	Auerswald, 1869 in Corlett, 1981
Citrullus (2)	watermelon	Chester, 1891
Cucumis (3)	cucumber; melon	Passerini, 1885 in Corlett, 1981
Cucurbita (5)	squash, pumpkin	Grossenbacher, 1909
Cyclanthera (1)	stuffing cucumber	Mendes et al., 1998 in Farr and Rossman, 2010
Lagenaria (1)	bottle gourd	Grossenbacher, 1909
Luffa (2)	loofah	Grossenbacher, 1909
Momordica (2)	bitter melon	Wiant, 1945
Sechium (1)	chayote	Wiant, 1945
Sicyos (1)	bur-cucumber	Greene, 1953 in Farr and Rossman, 2010
Trichosanthes (1)	snake gourd	Punithalingam and Holliday, 1972

Table 3. Comparison of geographic centers of origin for cultivated cucurbits and current distribution of *Didymella bryoniae.*

Crop	Center of origin	*D. bryoniae* occurrence
C. pepo ssp. *ovifera*	Central and eastern USA	USA
C. pepo ssp. *pepo*	Mexico	Mexico
C. moschata	Mexico; Andean South America	Mexico, Venezuela, Brazil
C. argyrosperma	Mexico, Central America	Mexico, Central America
C. maxima	Andean South America, Argentina, Uruguay	Venezuela, Brazil
C. lanatus	western, southern Africa; Egypt	Malawi, Tanzania, South Africa
C. colocynthis	northern Africa; India	India

[z]Host information from Robinson and Decker-Walters, 1997 and Pickersgill, 2007 and distribution of *D. bryoniae* from Farr and Rossman, 2010.

very unlikely that colocynth co-evolved with *D. bryoniae*. On the other hand, citron (*C. lanatus* var. *citroides*), which originated in southern Africa where *D. bryoniae* occurs, was the least susceptible of three *Citrullus* taxa evaluated (Levi et al., 2001). Citron also was less susceptible to gummy stem blight than watermelon cultivars (Keinath et al., 2009). In addition, *Cucurbita* spp. generally are less susceptible to gummy stem blight than *Citrullus lanatus* or *Cucumis* spp. (Keinath et al., 2009). This reduced susceptibility may be because the centers of origin and prehistoric ranges of *Cucurbita* spp. generally fall within geographic areas in which *D. bryoniae* currently is found (Table 3). Plants of *Cucurbita* spp. affected with crown cankers, to which *C. argyrosperma* is particularly susceptible, generally still produce an abundance of fruits, an important adaptation to colonization by a pathogen for the plant—and the domesticator.

In summary, the earliest reports of *D. bryoniae* were from *Bryonia* spp. in Europe in the second half of the 19th century. By the early 20th century, *D. bryoniae* had been found on most commonly cultivated cucurbits on both sides of the Atlantic Ocean. Currently, *D. bryoniae* is part of the global movement of pathogens and plant products, as it travels from continent to continent on and in seed. Because the fungus is well-adapted to cucurbits, it is able to rapidly colonize host tissue and reproduce abundantly. Thus, it is ideally suited to continue to plague cucurbits grown in humid environments.

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Poster Presentations

Posters will be displayed and presented on Wednesday, 17 November, from 3:00–5:00 pm in Carolina B

(Listed in alphabetical order. *Denotes presenting author)

Biotechnology & Physiology

Quantification of L-Citrulline and Other Physiologic Amino Acids in Watermelon and Selected Cucurbits
Wayne W. Fish* and Benny D. Bruton

Establishment of *Cucurbita maxima* Genetic Transformation System by Agrobacterium-mediated Method
HongBing Fu, ShuPing Qu, ChongShi Cui, ZhuGang Li*, and Xi Zhao

In Vitro Organogenesis of Cotyledons in Chieh-qua
Wei Han, Ee Liu, Xiaoming He*, Dasen Xie, and Qingwu Peng

Biotic and Abiotic Stress Tolerances are Enhanced in Transgenic Watermelon Overexpressing a Cucumber Galactinol Synthase Gene
Jae-Jong Noh*, Song-Mi Cho, Kwang-Sang Kim, Kwang Yeol Yang, Yong-Kyu Shin, and Baik-Ho Cho

The Comparison of Embryo Rescue and Direct-seeding Method for Generating Haploid Kirkagac and Yuva-Hasanbey Melons
Irmak Gursoy, Ilknur Solmaz, Serkan Kasapoğlu, Nebahat Sari*, Csaba Szamosi, and Kyoung-Sub Park

Directional Selection of Precocious Gene by Proton Beam and its Molecular Verification
Sun Xun*, Ren Canghua, Meng Hui, Shi Jinguo, and Tang Zhangxiong

Breeding & Genetics

Progress in the Development of Cucumber Breeding Lines with Low-temperature Resistance
Elzbieta U. Kozik*, Urszula Klosinska, and Todd C. Wehner

The Cucumber Genome Sequence is Useful for Localizing the Dwarf Mutant Bu in the Tropical Pumpkin (*Cucurbita moschata* Duchesne) Genome
Shenhao Wang, Haizhen Li, Zhonghua Zhang, Jun He, Changcai Jia, Fan Zhang, and Sanwen Huang*

Construction of Genetic Linkage Map and QTL Analysis for the Traits Related to Plant Height in Cucumber
Chen Xue-hao*, Ji Yi, Xu Qiang, and Liang Guo-hua

Evidence That Resistance to Gummy Stem Blight (*Didymella bryoniae*) in Dudaim Type Melons (*Cucumis melo* ssp. *agrestis*) is a Quantitative Trait
Kevin Crosby*, Daniel Leskovar, and Marvin Miller

Construction of an Intravarietal Genetic Map of Cucumber and its Comparison with the Melon Genetic Map
Nobuko Fukino*, Yosuke Yoshioka, Yoshiteru Sakata, and Satoru Matsumoto

Characterization of Fruit Ripening in the Melon Near Isogenic Line SC3-5
J. Vegas, J. Garcia-Mas*, and A.J. Monforte

Improvement of Inositol-rich Pumpkin Germplasm and New Variety Development
Gu Wei-hong*, Yang Hong-juan, Tang Qing-jiu, and Song Rong-hao

Differences among Citrullus Germplasm Accessions in Tolerance to Clomazone Herbicide
Howard F. Harrison, Jr.*, Chandresekar S. Kousik, and Amnon Levi

Construction of a Linkage Map and Location of QTLS of Resistance to Gummy Stem Blight in Melon
Youyuan Cheng, Longzhou Liu*, Weiming Zhu, and Zhenghoug Su

Development and Application of SSR-SNP Markers in Luffa
Wing-Yee Liu*, Kai-Cheong Ng, and Frederick C. Leung

Genetic Diversity in Watermelon Germplasm using SSR Markers
Yunyan Sheng, Feisi Luan*, and Faxing Zhang

Integrated Pest Management of Sweetpotato Whitefly and Cucurbit Yellow Stunting Disorder for Melon Production in the Desert Southwest United States
James D. McCreight*, Todd C. Wehner, and Angela R. Davis

Characterization of the Genetic Diversity of *Citrullus lanatus* var. *lanatus* Oleaginous in Ivory Coast at the Scale of a Village: Preliminary Results
L.-A. Minsart* and P. Bertin

Vegetative Growth in Bush *Cucurbita maxima* × Vine *Cucurbita moschata* Interspecies Hybrids
J. Brent Loy and Jacob B. Uretsky*

Culture & Management

Importance of Cucurbits in Market-gardening Production Systems
Tristan Nondah*

The Value of Fallow Crops for Soil Properties and Watermelon Yield in Plastic Film House Production
Mi Jeong Uhm*, Jae Jong Noh, Hyong Gwon Chon, Jeong Hyeon Lim, Mun Ho Seong, and Yong Kyu Shin

Kabocha Squash Variety Evaluations in New Jersey
M.L. Casella and C.A. Wyenandt*

Influence of Plant Density on Yield and Quality in Grafted Watermelon onto Bottle Gourd (*Lagenaria siceraria*) Rootstocks
Halit Yetışır* and Nebahat Sarı

Plant Growth Characteristics in Watermelon Grafted onto Different Bottle Gourds (*Lagenaria siceraria*) Collected from Southern and Western Turkey
Fatih Karaca, Halit Yetışır*, Elif Çandir, İlknur Solmaz, Nebahat Sarı, Şener Kurt, and Mehmet E. Çalişkan

Germplasm

Turkmenistan Melon (*Cucumis melo*), and Watermelon (*Citrullus lanatus*) Germplasm Expedition 2008
James D. McCreight*, Todd C. Wehner, and Angela R. Davis

Identification of Sources of Resistance to Gummy Stem Blight in Watermelon [*Citrullus lanatus* (Thunb.)]
M. Pitchaimuthu*, P. Chowdappa, R. Pushpalatha, Santhoesh Kumar, and K. Souravi

Identification of Resistance to *Acidovorax avenae* subsp. *citrulli* among Melon (*Cucumis* spp.) Plant Introductions
W. Patrick Wechter*, Kai-Shu Ling, Amnon Levi, Chandrasekar Kousik, and Charles C. Block

Grafting & Rootstocks

Employing Phylogenetic Analysis to Identify Rootstock Resources for Grafted Watermelon
Amnon Levi*, Judy Thies, Patrick Wechter, Chandrasekar Kousik, Richard Hassell, and Umesh Reddy

Grafting Improvement on Photosynthesis and Carbohydrate Metabolism of Muskmelon Leaves
Yifei Liu*, Tianlai Li, Hongyan Qi, Weizhi Chen, Mingfang Qi, and Chunming Bai

Plant Pathology

Phenotypic Diversity of *Phytophthora capsici* Isolates from a Worldwide Collection
L.L. Granke*, L.M. Quesada-Ocampo, and M.K. Hausbeck

Effect of Reflective Mulch and Insecticidal Treatments on Development of Watermelon Vine Decline Caused by Squash Vein Yellowing Virus
Chandrasekar S. Kousik*, Scott Adkins, Craig G. Webster, William W. Turechek, Phil Stansly, and Pamela D. Roberts

Temporal Population Dynamics of Cucurbit Powdery Mildews (*Golovinomyces cichoracearum* and *Podosphaera xanthii*) in the Czech Republic
Božena Sedláková and Aleš Lebeda*

Differences in Virulence of *Phytophthora capsici* Isolates from a Worldwide Collection on Zucchini Fruits
L.M. Quesada-Ocampo*, L.L. Granke, and M.K. Hausbeck

Fungicides for Organic Cantaloupe Production in Oklahoma: An Initial Assessment
Jim Shrefler, Merritt Taylor, Warren Roberts, and Benny D. Bruton*

“Practical” Fungicide Resistance and Cross-resistance Development in Cucurbit Powdery Mildew of Pumpkin in New Jersey
Christian A. Wyenandt*, Daniel L. Ward, and Nancy L. Maxwell

Pathogenicity of *Verticillium dahliae* to Gourd Species and Effectiveness of Gourd Rootstocks against Verticillium Wilt in Watermelon Production
Sibel Dervis, Halit Yetışır*, and Fatih Karaca

Incidence and Transmission of Zucchini Yellow Mosaic Potyvirus (ZYMV) in Cucurbits in Hatay Province of Turkey
Gülşen Sertkaya, Erdal Sertkaya, Halit Yetişir*, and Kamuran Kaya

Postharvest

Storage and Shelf Life of Grafted Watermelons
A. Erhan Ozdemir*, Elif Candir, Halit Yetisir, Veysel Aras, Omer Arslan, Fatih Karaca, and Durmus Ustun

Comparison of Methods for Chlorophyll Estimation in Cucumber Peel
Penelope Perkins-Veazie*, Guoying Ma, and Todd Wehner

Virology

Screening Summer Squash Cultivars (*Cucurbita pepo* L.) for Resistance to Squash vein yellowing virus
Susan E. Webb

Incidence and Molecular Characterization of Cucumber green mottle mosaic virus in Cucurbit Crops of North West Frontier Province, Pakistan
Asad Ali*, Adil Hussain, Musharaf Ahmad, and Ishrat Naz

Cucurbitaceae 2010

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